Without attaching much value to either hypothesis, the author prefers the latter, and remarks in conclusion that there can be little doubt that many new series of organic acids may, by analogous processes, be produced from inorganic acids by the replacement of one or more atoms of oxygen by an alcohol radical; in fact his pupil, Mr. Hobson, is now engaged in the study of a new series containing sulphur, produced by the action of zincethyl and its homologues upon sulphurous acid. These acids are formed by the replacement of one equivalent of oxygen, in three equivalents of sulphurous acid, by an alcohol radical.

IX. "On the Action of Urari and of Strychnia on the Animal Economy." By Professor Albert Kölliker of Würzburg. Communicated by Dr. Sharpey, Sec. R.S. Received May 31, 1856.

The communication which I now offer to the Royal Society contains a brief statement of the results of a series of experiments which I lately made on the action of the urari poison and of strychnia on the animal economy.

I. Urari.

The urari is the well-known poison from Guiana, also called Curare and Woorara. That which I employed in my experiments I owe to the liberality of my friend Professor Christison of Edinburgh. The following are the conclusions at which I arrived respecting its operation:—

1. The urari causes death very rapidly when injected into the blood or inserted into a wound; when introduced by way of the mucous membrane of the intestinal canal its effects are slow and require a large dose for their production, especially in mammalia. When applied to the skin of frogs it is altogether inoperative.

2. Frogs poisoned with very small doses of urari may gradually recover, even after it has produced complete paralysis of the nerves. Mammalia may also be restored, even after large doses, provided respiration is maintained artificially.

3. The urari, *acting through the blood, destroys the excitability*

of the motor nerves. In frogs under its operation the terminal branches of these nerves within the muscles lose their excitability in a few minutes, whilst their trunks become affected an hour or two later. If, after the nervous extremities have become paralysed, the heart of the animal be excised so as to prevent the nerves from receiving any further share of the poison, the nervous trunks may retain their excitability for three or four hours.

4. The brain is less affected by the urari than the nerves in the muscles; still when, by ligature of the two aortic arches, in frogs, the poisoning is confined to the anterior half of the body, the voluntary movements of the limbs speedily cease, whilst automatic movements, of doubtful nature and probably proceeding from the medulla oblongata, may be still observed for half an hour or an hour after the poison has begun to operate.

5. The spinal cord is considerably less affected than the brain by this poison, and by local limitation of the poisoning (as in No. 4), it is found that the cord retains its *reflex activity* from half an hour to an hour and a half, and the excitability of its white substance or its conducting power from two to three hours after the poison has taken effect. It is worthy of remark that in such cases the impaired reflex activity of the spinal cord may be revived by strychnia directly applied to it.

6. The *sensory nerves,* as shown also by locally limited poisoning, retain their functional activity as long at any rate as reflex actions can be excited, and when the depressed reflex activity has been revived by means of strychnia, these nerves are found not to have been in the slightest degree injured, so that it seems doubtful whether the urari in any way affects them.

7. *The nerves of the involuntary muscles and of the glands* are also paralysed by the action of urari, at least I find this to be true in the following cases, viz.—

a. The pneumogastric, as regards its influence on the heart.

b. The sympathetic (its cervical portion), in its relation to the iris.

c. The nerves of the posterior lymph-hearts of the frog.

d. The nerves of the vessels in the web of the frog's foot.

e. The splanchnic nerves of the rabbit, as affecting the peristaltic motions.

f. The nerves governing the secretion of the submaxillary gland in dogs.

8. *The voluntary muscles* remain perfectly excitable, but show a greater tendency than usual to merely local contractions. In general the cadaveric rigidity of these muscles appears to set in later than usual.

9. *The plain or non-striated muscles* also remain long irritable after poisoning by urari.

10. The heart, in amphibia, is little affected by urari. Its pulsation as well as the circulation of the blood goes on regularly for many hours after the poisoning is established. The only thing worthy of note is that the beat of the heart appears to be somewhat quickened, probably from paralysis of the pneumogastric nerves. In frogs poisoned with urari, the heart, when cut in two, shows the usual phenomenon, namely, that the half which contains the ganglia continues to pulsate whilst the other does not; from which it may be inferred that these ganglia are not paralysed. As to the nerves in the substance of the heart, those at least which are derived from the pneumogastric are unquestionably paralysed (vide No. 7).

11. The lymph-hearts of frogs poisoned with urari soon cease to move.

12. The blood of animals poisoned by urari is fluid and dark, but coagulates when drawn from the vessels, and forms a weak clot which is but little reddened by exposure to air. Directly mixed with blood, urari does not prevent coagulation, but the blood in this case also remains dark and scarcely reddens on exposure.

13. The blood of animals poisoned by urari has the same poisonous qualities as that substance itself, but not in a degree sufficient to produce the full effects of the poison. Urari when directly mixed with blood loses none of its efficacy.

14. Urari, in concentrated solution, applied locally to nerves extinguishes their excitability, but only after a considerable time, and it appears to act similarly on the nerves in the substance of the muscles. Dilute solutions have no injurious operation. Applied directly to the brain and spinal cord, urari is altogether harmless provided its absorption be prevented.

15. When artificial respiration is kept up in quadrupeds poisoned with urari, I find that, as observed by Bernard, many of the secre-

tions become increased—as the tears, saliva, urine and mucus of the air-passages, which effect appears to be owing to the paralysis of the vascular nerves and consequent dilatation of the vessels caused by the poison.

16. In mammalia urari causes death by paralysis of the respiratory nerves and suppression of the respiration, which brings on convulsions in these animals as a collateral effect. In frogs the final extinction of the functions may also be partly ascribed to suppressed action of the lungs and defective oxidation of the blood, which at length renders the heart unfit to perform its office; but it must be observed that in this case the cause of death is not so plain, inasmuch as in these animals the functions are in a great degree independent of the pulmonary respiration.

II. Strychnia.

Some experiments with strychnia (the acetate) gave the following results:—

1. Strychnia has not the least influence on the peripheral nerves through the blood, which is best shown by cutting the nerves before administering the poison.

2. Strychnia paralyses the motor nerves of the voluntary muscles by exciting them to too energetic action, a paralysis which may be compared to that caused by powerful electric currents acting upon the nerves. In frogs, when the tetanic spasms are over, the nerves often show no trace of excitability; in mammalia they generally retain it in a slight degree, but never show the same energy of action as when uninjured.

3. Strychnia does not affect the sensory nerves.

4. The heart is not affected by strychnia, not even during the tetanic spasms, with the exception only that its pulsations are sometimes a little slower during the tetanic state. On the contrary, the lymph-hearts of frogs contract themselves as soon as the tetanus begins, and remain in this state as long as the spasms last.

5. The tetanic fits can be brought on in two ways; first, through *the sensory nerves*, which, by irritating the grey substance of the spinal cord, produce the tetanic contractions as reflex movements; and, secondly, *through the brain*, which is not affected at all by strychnia and preserves its powers of volition and sensation. Accord-

ingly, animals poisoned with strychnia try to move in the ordinary way, but every attempt brings on a tetanic fit, so that it is plain that the spinal cord may also be excited by the brain to its peculiar actions.

6. If the tetanus produced by strychnia has been strong, the *muscles are less irritable* and pass much sooner into the state of *cadaveric rigidity*, which is very strongly marked, and seems to last longer than it generally does. The same early onset of rigidity may be observed in animals killed by tetanus excited by electricity.

X. "Researches on the Foraminifera."—Part II. By William B. Carpenter, M.D., F.R.S., F.G.S. &c. Received June 19, 1856.

(Abstract.)

In the pursuance of his plan of minutely examining certain typical forms of Foraminifera, for the purpose of elucidating their history as living beings, and of determining the value of the characters they present to the systematist, the author in this memoir details the results of his investigations on the genera *Orbiculina*, *Alveolina*, *Cycloclypeus*, and *Heterostegina*.

The genus *Orbiculina* has long been known, through its prevalence in the West Indian seas, which causes its shells to abound in the shore-sands of many of the islands of that region. These shells present great varieties of form, and have been ranked under three distinct species; but M. d'Orbigny has correctly inferred, from a comparison of a large number of specimens, that their diversities of form are partly attributable to differences in the stage of growth, and partly to individual variation, so that all the *Orbiculinæ* of Cuba, the Antilles, &c., are referable to but one specific type. Of the essential features of its structure, however, he would seem to be quite ignorant; since he ranges *Orbiculina* in a distinct order from *Orbitolites*, to which it is very closely allied. This alliance was first pointed out by Prof. Williamson, whose account of the structure of Orbiculina, though defective and erroneous in certain points, is nevertheless correct in the main.

The author has had the opportunity of examining not merely a